REMARKS/ARGUMENTS

The Examiner had objected that the title was not descriptive. The title has been amended accordingly, and is now submitted to be adequate and descriptive.

For paragraph [0038], the Examiner had asked for the status of the non-provisional application to be updated, and the patent number has now been inserted, and a similar amendment has been entered to paragraph [0043].

The Examiner had noted that the disclosure contained a number of words that were incomplete and were missing letters. The reason for this is not clear. Our file copy shows no such errors. However, we have downloaded a copy of the specification as received by your office from your website, and are entering all corrections required in this respect. This includes the objections noted by the Examiner to claims 4, 7 and 8, and numerous other similar corrections.

The Examiner then rejected the claims under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner had difficulty with a number of the terms used in the claims.

In response, a number of amendments have been made to the claims to clarify the system and method claimed. These are detailed below in the order in which they occur.

Considering first claim 1, element (c) of claim 1 has been amended so that it now defines a "measurement means" for determining "at least one fuel cell operation characteristic", which in turn is specified as being "indicative of the power output of the fuel cell", and as "having a fuel cell operation characteristic spectrum". As further specified in claim 2, the "operation characteristic" is some measure of the power output of the fuel cell. Commonly, this will comprise measuring current or current density, which in combination with the voltage will give the actual power output.

A reference to a "characteristic spectrum" is simply intended to indicate that, as detailed in the specification, the measured current, for example, will have a spectrum of values ranging from zero to some maximum level, corresponding to the power output of the fuel cell. As mentioned, measurement of the current would be

"indicative" of the actual power, and can be converted to the actual fuel cell power output by also utilizing the fuel cell voltage.

Claim 1 further specifies that the system includes a controller for controlling the operation of the "at least one fuel cell peripheral" based on the fuel cell operation characteristic.

As further detailed below, to distinguish from the known art, it is now specified in claim 1 that the "at least one fuel cell peripheral" comprises at least one of: a coolant recirculation pump; a hydrogen recirculation pump; and a hydrogen purging means.

Claim 1 now further specifies that the "fuel cell operation characteristic spectrum", previously defined and discussed above, is divided into at least two ranges indicative of at least two corresponding ranges of power output. Thus, in the case of measurement of the fuel cell current, this simply means that the measured current values are divided into two ranges, which typically can be from zero to some mid-point and from that mid-point to a maximum value. Clearly, again for the case of current measurement, these two ranges would each be indicative of separate ranges of power output.

What the present invention then realizes is that different ranges or power levels of a fuel cell require different levels of operation of the fuel cell peripherals. As detailed in the specification, current common practice is simply to operate all of the peripherals at some maximum level, to ensure adequate cooling, recirculation, etc., at maximum power levels; the disadvantage of this approach is that at lower power levels, one still has all the peripherals working at a maximum level, resulting in unnecessarily large, parasitic loads from these peripherals, thereby reducing the overall efficiency of the whole fuel cell system at low power levels.

What the present invention thus realizes is that at lower power levels for the fuel cell system as a whole, these fuel cell peripherals can, correspondingly, be operated at a lower level. For simplicity, this is done by considering the power output spectrum of the fuel cell to comprise a number of ranges, and then to specify a corresponding "operational characteristic" for each range for the respective fuel cell peripheral. A detailed example is given at page 15 of the specification, where Table 1

shows, in tabular form, how the hydrogen purge frequency and hydrogen recirculation frequency can be adjusted, depending upon whether the current density falls into one of five different specified ranges.

With respect to the other claims, the subject matter of claim 3 has been effectively incorporated into claim 1, so this claim is being deleted. Clarifying amendments are being entered into claims 2 and 4.

The main method claim, claim 6 has been amended, following the amendments to claim 1.

A new claim 11 with dependent claims 12-14 is being introduced. Claim 11 is similar in some respects to claim 1. However, the fuel cell peripherals are defined in claim 11 as being fuel cell peripherals "capable of being run at a constant operational characteristic". No new matter has been added, and the Examiner is referred to the start of paragraph 47, and elsewhere in the specification, for support for this amendment. The principal here is that, as detailed in the specification, conventional teaching is that fuel cell peripherals should, for simplicity, be run at some constant rate, and typically this is set to ensure adequate operation at maximum power levels. Again, this leads to excessive parasitic loads. Again, this leads to excessive parasitic loads at lower power levels. Dependent claims 12, 13 and 14 correspond to former claims 2, 3 and 5.

Claims 15 and 16 are corresponding new method claims.

New claims 17-20 are directed to other aspects of the invention, namely details of recirculation of the reactants and coolant circuits.

To comment on the Examiner's individual objections to the claims, the Examiner had argued that there was no antecedent basis for "the spectrum" in line 11 of the claim. As noted, element (c) of claim 1 has been amended to introduce a clear antecedent basis for this term.

In claim 9, the Examiner had argued that the limitation "the range of the fuel cell operation characteristic" similarly had insufficient antecedent basis. In reply, claim 9 has been amended to introduce the feature of step (b) comprising determining a "current operating range of the fuel cell system", and then the final paragraph of claim 9 has been amended to refer to "the current operating range of the fuel cell system".

In claim 10, the Examiner had, similarly, argued that the limitation "the plurality of levels of the at least one fuel cell operation characteristic" in lines 13 and 14 of the claim lacked sufficient antecedent basis. Claim 10 has been amended to specify that the fuel cell operation characteristic spectrum includes a plurality of ranges, with one range being an idle level, etc. It is therefore submitted that there is now appropriate and correct antecedent basis for all the terminology used.

The Examiner then rejected all of the claims under 35 U.S.C. 102 based on three cited references. In view of the amendments to the claims and the arguments submitted below, it is submitted that the invention as now claimed is clearly not anticipated, within the meaning of 35 U.S.C. 102, appropriate paragraph.

An overriding consideration, when looking at the prior art collectively, is that none of the prior art is concerned with operating fuel cell peripherals. In general, all the prior art is concerned with controlling the supply of reactants to a fuel cell system, so that the reactant supply matches the load and power delivered by the fuel cell system. Indeed, many of them are wholly silent on details of the structure of the fuel cell and the nature of fuel cell peripherals.

Considering first Blum et al., this is concerned with controlling the fuel processing system 1 and an oxidant system 2 for supply of appropriate reactants to a fuel cell 3. One can note that the fuel cell 3 is shown as having inlets for the reactants, but no outlets, and no concept of recirculation. Intriguingly, Figure 1 of Blum et al. shows a current I_{Sys} which is stated to be consumed by "auxiliary equipment (parasitic loads)" See line 10 of the right-hand column of page 3. There is no discussion that this load could be varied depending upon the load supplied by the fuel cell. Rather, the whole teaching of this patent is simply to match the supply of the reactants to the power demand, to ensure generation of the appropriate power levels.

The Examiner made specific reference to Figure 3 of Blum et al. Again, this is solely concerned with ensuring that the fuel and hydrogen flow rates correspond with the target current required by the system, without any realization or suggestion that operating levels of peripherals can be adjusted to reduce parasitic power loads.

The Examiner then rejected claims 1 and 6, at least, as being anticipated by Harashima '641. Harashima is, similarly, wholly silent on the issue of adjusting power delivered to parasitic loads.

Harashima is specifically concerned with managing transients when there is a sudden change in external output power required. As Figure 3 of this patent shows, in such a situation, the prior art has provided inadequate response, with the flow rate of reformed gas overshooting that required, so that the output reference voltage drops excessively and the reference current goes too high. Figure 4 shows an arrangement where these characteristics are managed to prevent this, in accordance with the invention of this patent. The Examiner also referred to Figure 6 showing a second embodiment of the invention and alternative characteristics for gas flow, output voltage and output current.

Again, Harashima is silent on controlling peripherals that are independent of the load requirement and which can and commonly are run at constant levels. Thus, Figure 6 of Harashima merely discusses adjusting the flow rate of reformed gas. There is no discussion of, for example, controlling the flow rates of coolant, various blowers and the like, flow in recirculation circuits.

Finally, the Examiner rejected claims 1-10 as being anticipated by Ueda et al. Ueda is concerned with controlling an air supply means and a hydrogen supply means, dependent upon the load. An output command device 10 issues output command to the output control means 4, and a flow rate of control device 11 controls the hydrogen supply means 2 and the air supply means 3. As the main claim details, an algorithm is provided for determining a command value based on the average value of the detected power and a predetermined period.

Again, Ueda et al. are notable for being entirely silent on the issue of controlling peripheral devices which are not devices concerned with supplying reactants and which can be run at a constant rate.

With respect to claims 2-3 and 7-8, the Examiner referred to parts of Ueda et al. that he argued teach that, at an external load command, a power control unit 35 controls a flow rate control unit 36 which controls the flow rate of hydrogen supply by the hydrogen supply means. The claims have now been amended to remove the control

of a reactant supply means as being one of the listed fuel cell peripherals, so that this rejection is no longer applicable.

With respect to claims 4 and 9, the Examiner argued that Ueda et al. disclose the employment of output control means of accumulating a time at which a detected power requested by the load is equal to or larger than a predetermined value. Again, it is not seen how this is in any way applicable. There is certainly no teaching of having ranges of values in a characteristic spectrum, within the sense of the present invention.

With respect to claims 5 and 10, these claims are submitted to be allowable as dependent from other allowable claims. The idle level feature of these claims is not disclosed by Ueda et al. in the manner suggested by the Examiner.

Accordingly, it is submitted that the claims as amended are now in order for allowance, and early review and allowance are requested.

Respectfully submitted,

BERESKIN & PARR

By _____

H. Samuel Frost
Reg. No. 31,696
Tel: 416-364-7311